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BIOMASS GASIFIER

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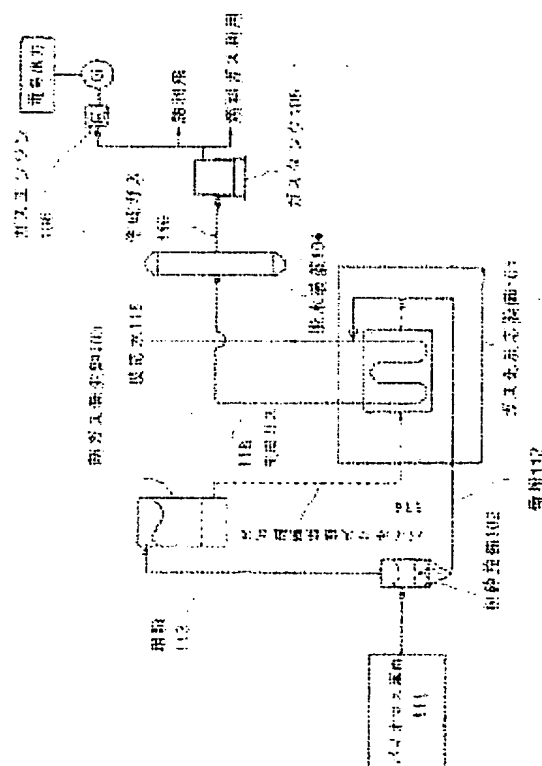
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Abstract of JP 2004051717 (A)

PROBLEM TO BE SOLVED: To provide a biomass gasifier, which may be a small-scale one, that produces a highly calorific clean fuel gas suited for a power generation gas engine in high yields from biomass resources. ; **SOLUTION:** In the biomass gasifier wherein steam is fed into crushed biomass to cause a gasification reaction in a gasification space, the gasification space is isolated from external heating by a partition, and the gasification reaction of the steam with the biomass is caused by an endothermic reaction without actively feeding oxygen into the gasification space. The partition has a gasification space in its inside, the inner side space for gasification by the external heating has a tubular structure, and the gasification space has a spouted bed structure in which the fed biomass powder is fluidized with the fed steam. ; **COPYRIGHT:** (C)2004.JPO



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CLAIMS

[Claim(s)]

[Claim 1]

Supply a steam to the pulverized biomass and gasification space which produces and heats out of a gasification reaction, and this gasification space are divided into it with heat tracing via a septum, In a gasifier of the biomass which produces a gasification reaction of a steam and the biomass by an endoergic reaction and out of which it heats without supplying oxygen to gasification space positively at **, A gasifier of the biomass being the entrained bed structure of making a biomass granular material which said septum has gasification space inside, gasification space by the side of inner circumference by heat tracing is formed in tubular body structure, and said gasification space supplies mobilizing with a steam to supply.

[Claim 2]

Supply a steam to the pulverized biomass and gasification space which produces and heats out of a gasification reaction, and this gasification space are divided into it with heat tracing via a septum, In a gasifier of the biomass which produces a gasification reaction of a steam and the biomass by an endoergic reaction and out of which it heats without supplying oxygen to gasification space positively at **, Said septum has gasification space inside, it is formed in tubular body structure by gasification space by the side of inner circumference by heat tracing, and in said gasification space, A gasifier of the biomass while a steam and the biomass set up both flow direction in the direction which intersects a counterflow or a steam flow direction, wherein it extracts to this contact area or an expansion region (diffuser) exists.

[Claim 3]

Supply a steam to the pulverized biomass and gasification space which produces and heats out of a gasification reaction, and this gasification space are divided into it with heat tracing via a septum, In a gasifier of the biomass which produces a gasification reaction of a steam and the biomass by an endoergic reaction and out of which it heats without supplying oxygen to gasification space positively at **, A gasifier of the biomass which high temperature gas flows out and is characterized by locating a gasification part which performs a gasification reaction of a reaction water evaporator, a steam, and the biomass within a bend with which two or more free end openings insert a bend located outside in heating space which carries out ON, and are put to heating space in it.

[Claim 4]

While branching a bend immediately after secondary gasification part passage in said bend from a biomass supply side, turning this branch pipe upward and carrying out a bend from facing down, A gasifier of the biomass according to claim 3 characterized by forming an ashes drain at a fuel gas outlet part and a pars-basilaris-ossis-occipitalis turning part of facing up [facing down] on the other hand in said upward free end.

[Claim 5]

Claim 3 performing a substantial seal with reaction water which provided a header which connects said many tube parts in the free end by the side of reaction water of these many tube parts, and with which this header was filled up while said bend is inserted in heating space in the shape of many pipes, or a gasifier of the biomass given in four.

[Claim 6]

Claim 3 performing a substantial seal by the biomass which provided a header which connects said many tube parts in the free end by the side of the biomass of these many tube parts, and with which this header was filled up while said bend is inserted in heating space in the shape of many pipes, or a gasifier of the biomass given in four.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The field of the technology in which invention belongs]

This invention relates to the equipment which makes clean high calorie gas generate from the biomass in detail about effective use of the biomass. In the conventional biomass energy usage pattern, it is related with the gasifier of the biomass used combining the gas engine of a feed system or cogeneration system with high system generation efficiency which is not obtained.

[0002]

[Description of the Prior Art]

In the utilization system performed by changing into electrical energy or thermoelectrical both energies among the conventional biomass energy use process defined systems, the system which burns directly considering the biomass as boiler fuel, makes high-pressure steam generate, and rotates the turbine for power generation has performed. Therefore, since at least 5000-10000 kW and an equipment scale become large, large quantity intensive generating of biomass resources or extensive collection is required. In addition, a large sum investment is needed. A use process defined system of the biomass resources whose efficiency it is small-scale and is higher than anything since it has stopped at the level of 10% by the case where the generation efficiency is a 5000-kW scale is desired.

[0003]

On the other hand, since high generation efficiency is acquired in power generation of gas-engine use even when it is small-scale, in the society and natural environment which biomass resources generate dispersively like our country, the necessity for the gasifier technology of the biomass is high.

[0004]

Although research and development in the so-called thing of the internal combustion type which is a fixed-bed and fluid bed type gasifier, and set from before the space of the gasification which is an endoergic reaction, and the exothermic space by combustion as common space by using oxygen or air as a main gasifying agent about the gasifier technology of the biomass has been done, Tar and soot carry out a byproduction and quality does not suit as an object for gas engines. In addition, in using air, into production gas, nitrogen remains and it reduces the calorific value of unit production gas. In using oxygen, an air separation process is independently required and the energy and plant-and-equipment investment which operation takes become an energy efficiency fall factor and a cost push factor.

[0005]

Otherwise, although research of the gasifier by critical pressure hot water is done, the region of utilization is not arrived at including the problem of super-high-temperature-high-pressure equipment.

[0006]

[Problem to be solved by the invention]

This invention is a high calorie which was made in view of this conventional problem, and suits the gas engine for power generation from biomass resources, and it aims at the thing which acquire clean fuel gas with high yield and for which the gasifier of the possible biomass is provided even when it is small-scale. In addition, the synthetic energy conversion efficiency of biomass resources is raised, and it is considered as a contribution plug at the use spread as the third new energy.

[0007]

[Means for solving problem]

Supply a steam to the biomass which the gasifier of the biomass of this invention pulverized, and the gasification space which produces and cheats out of a gasification reaction, and this gasification space are divided into it with heat tracing via the septum. In the gasifier of the biomass which produces the gasification reaction of a steam and the biomass by an endoergic reaction and out of which it cheats without supplying oxygen to gasification space positively at **, Said septum has gasification space inside, the gasification space by the side of the inner circumference by heat tracing is formed in tubular body structure, and said gasification space is characterized by being the entrained bed structure of making the biomass granular material to supply mobilizing with the steam to supply.

[0008]

Heat required for decomposition of the biomass by radiation from the coil wall which does not have on gasification space chemically. supplying in the heat source prepared separately — in addition, a gasifying agent's own steam is used as a bed material, the local overheat by oxidation reaction etc. is avoided, and it is considered as the structure in which it is prompt and the gasification without a side reaction is possible by making the gasification atmosphere of the shape of a uniform jet. As for the heat source prepared separately, it is preferred to arrange and supply the heat gas producer which burns the biomass and generates heat gas. This biomass for heat sources can also use the biomass of a low grade from the raw material for gas decomposition.

[0009]

Supply a steam to the biomass which a gasifier of the biomass of this invention pulverized, and gasification space which produces and cheats out of a gasification reaction, and this gasification space are divided into it with heat tracing via a septum. In a gasifier of the biomass which produces a gasification reaction of a steam and the biomass by an endoergic reaction and out of which it cheats without supplying oxygen to gasification space positively at **, Said septum has gasification space inside, it is formed in tubular body structure by gasification space by the side of inner circumference by heat tracing, and in said gasification

space, While a steam and the biomass set up both flow direction in the direction which intersects a counterflow or a steam flow direction, it extracts to this contact area, or an expansion region (diffuser) exists. Organization which the biomass diffuses in a steam and gasifies promptly by a floating state by this is built.

[0010]

Supply a steam to the biomass which a gasifier of the biomass of this invention pulverized, and gasification space which produces and cheats out of a gasification reaction, and this gasification space are divided into it with heat tracing via a septum, In a gasifier of the biomass which produces a gasification reaction of a steam and the biomass by an endoergic reaction and out of which it cheats without supplying oxygen to gasification space positively at **, High temperature gas flows out, two or more free end openings feed a bend located outside into heating space which carries out ON, and a gasification part which performs a gasification reaction of a reaction water evaporator, a steam, and the biomass within a bend put to heating space is located.

[0011]

While the gasifier of the biomass of this invention branches the bend immediately after the gasification part passage in said bend from a biomass supply side, turning this branch pipe upward from facing down and considering it as a bend, The ashes drain was established in said upward free end at the fuel gas outlet part and the pars-basilaris-ossis-occipitalis turning part of facing up [facing down] on the other hand. That is, in the gasification reaction of this invention, free carbon like tar and soot is not generated, but the only solid impurities are ashes of inorganic substance origin. This impurity to accumulate is accumulated and it is considered as the structure to remove.

[0012]

The gasifier of the biomass of this invention provides the header which connects said many tube parts in the free end by the side of the reaction water of these many tube parts, and performs a substantial seal with the reaction water with which this header was filled up while said bend is inserted in heating space in the shape of many pipes. By providing gasification space in the shape of many pipes, gasification space can be reinforced compactly.

[0013]

The gasifier of the biomass of this invention provides the header which connects said many tube parts in the free end by the side of the biomass of these many tube parts, and performs a substantial seal by the biomass with which this header was filled up while said bend is inserted in heating space in the shape of many pipes.

[0014]

The grinding means to which the gasifier of the biomass of this invention is provided with the grinding means of 1 mm or less made microparticulate, and makes said biomass microparticulate preferably 3 mm or less for example, What is necessary is for the means which combined the crusher and the impact mill to be used, and for a screen exception to make the biomass with difficult pulverizing timely, and just to use it as fuel made to generate the heat gas for gasification space heating.

[0015]

[Mode for carrying out the invention]

An embodiment of the invention is described in detail with reference to Drawings below. However, the size of the product indicated to this embodiment, form, construction material, its relative configuration, etc. are not the main point that limits the range of this invention only to it but only mere examples of explanation, as long as there is no specific description in particular.

[0016]

(Embodiment 1) Drawing 1 is a flow chart of the bioenergy utilization system centering on the gasification reaction equipment which generates floating and outside heat type quantity calorie gas of this invention. The gasification reaction equipment 101 is provided with the coil 306 (drawing 2, three references) mentioned later, and this coil 306 receives the reaction water 115 and the biomass fines 112, and it is constituted so that it can heat with the biomass combustion high temperature gas 114 from the exterior. The crushing equipment 102 receives the biomass raw material 111, has the mean particle diameter of 3 mm or less, and the desirable performance which can generate fines of 1 mm or less, classifies the fines 112 with a mean particle diameter of 3 mm or less and the coarse powder 113 exceeding the mean particle diameter of 3 mm, and has the structure which can be discharged. In this example, it used combining the crusher and the impact mill. The heat gas producer 103 receives the biomass coarse powder 113, burns the biomass coarse powder 113 by susceptibility-of-substances-to-burn agents, such as air, and generates the hot biomass combustion high temperature gas 114. The dehydrator 104 has a cooling heating surface in an inside, condenses high boiling point material, such as moisture, a sulfur compound, etc. in the gas introduced in the tower, and has a removable structure. The gas tank 105 is a water seal-type tank and has structure which can store the production gas 116. The gas engine 106 burns the production gas 116 in this example, and has the ability to operate a dynamo.

[0017]

In drawing 1, the biomass raw material 111 is supplied to the crushing equipment 102, and is divided into the fines 112 with a mean particle diameter of 3 mm or less and the coarse powder 113 exceeding the mean particle diameter of 3 mm, The coarse powder 113 is sent to the heat gas producer 103, and the fines 112 are introduced with the reaction water 115 into the coil 306 under gasification reaction equipment 101. In the heat gas producer 103, the biomass coarse powder 113 is burned with the combustion temperature of 900–1200 **, the coil 306 under gasification reaction equipment 101 is heated from the outside with the biomass combustion high temperature gas 114 emitted, and the temperature in a pipe is kept at not less than 800 **. The fines 112 introduced in the coil 306 float in the steam air current generated with the introduction reaction water 115, and are gasified mostly in an instant (0.2 or less second). After introducing the hydrous production gas 108 into the dehydrator 104 and removing a part (HCl) for moisture, sulfur content (H₂S), and chlorine, it is considered as the production gas 116 and stores in the gas tank 105. The production gas 116 has a calorie of about 20 MJ/m³, and suits as fuel for gas engines. A 1 t (50 – 100 kg/h)/day biomass throughput was able to be processed by this system, and when changed into electrical energy with a 30–kW dynamo, total energy efficiency was able to be made into not less than 20%.

[0018]

(Embodiment 2) Drawing 2 is the gasification reaction equipment 101 of this invention, and a schematic diagram of an example of primary gasification part 302 details. In drawing 2, the gasification reaction equipment 101 had the coil 306 in heating chamber 307 inside, and the heating chamber 307 is provided with the feed port of the biomass combustion high temperature gas 114, and the outlet. A coil is a bend which connected the pipe of U character, the inverted-U character, and U character, and there are the first vertical section, the second vertical section, the third vertical section, and the fourth vertical section from right-hand side. The open end which can introduce the reaction water 115 from the first vertical section upper part of the right end, The open end which can introduce the biomass fines 112 from the second vertical section upper part of halfway, The open end which

takes out the hydrous production gas 118 which the open end which takes out the ashes 117 by which it is generated by gasification from the U tube pars basilaris ossis occipitalis which connects the second vertical section of halfway and the third vertical section generated by the gasification reaction from the fourth vertical section of a left end is provided, respectively.

[0019]

The gasification reaction equipment 101 introduces the biomass combustion high temperature gas 114 generated with an unillustrated heat gas producer from a feed port of said heating chamber 307. The coil 306 is heated from the exterior, and temperature and a flow of the biomass combustion high temperature gas 114 (heat tracing gas) are adjusted so that the internal temperature may be maintained to a suitable temperature of not less than 800 °C. The reaction water 115 is made to gasify, making the biomass fines 112 which were heated by heat tracing gas in the reaction water evaporator 301 of the first vertical section, became a steam, and were introduced from the upper part by the primary gasification part 302 of the second vertical section float. At this time, an input of the reaction water 115 and the fines 112 is adjusted so that a mole ratio of a steam/biomass may become 0.4 or more. Gasified production gas is poured, flows into the secondary gasification part 303 which comprises the third vertical section and the fourth vertical section, and disassembles a little tar and soot which carried out the byproduction. All of a solid organic matter and carbon are decomposed in this portion, and it becomes atmosphere, and a solid serves as only ash which consists of inorganic substances, and takes out the ashes 117 from said ashes extraction open end. The production gas 118 is taken out from said fourth vertical section open end of a left end, where moisture, a little H₂S, and HCl are still included.

[0020]

Details of the primary gasification part 302 like a graphic display near the lower part of the coil 306. The conical (reverse truncated cone) mold current plate 307 which has the opening 308 in the center is formed, high temperature steam is blown from this opening 308, and it gasifies in the state where the biomass fines 112 thrown in from the coil 306 upper part were made to float. Gasification made into the purpose of primary gasification, i.e., this invention, is performed in the primary gasification field 304, and the upper part of the third vertical section that passed this field functions as the secondary gasification field 305, and plays the same role as the secondary gasification part 303 explained above.

[0021]

(Embodiment 3) Drawing 3 is gasification reaction equipment of this invention, and a schematic diagram of other examples of the details of a primary gasification part. The entire configuration of gasification reaction equipment is the same as that of Embodiment 2. The composition of primary gasification part 401 details has become like a graphic display. That is, in primary gasification part 401 details on the right-hand side of drawing 3, the dispersing pipe 402 is inserted into the coil 306, the dispersing pipe 402 — a fines feeding pipe — pars-basilaris-ossis-occipitalis reverse — the end of internal hollow which comprises a curved surface which extends towards the conical bottom circumference — reverse — it is conical and is the closed cylinder — this pars-basilaris-ossis-occipitalis reverse — it has two or more rocket engine jets 405 on the curved surface which extends towards the conical bottom circumference.

[0022]

When this dispersing pipe 402 was inserted in said coil 306, the distance near the reverse conical bottom circumference section of the dispersing pipe 402 and between coil 306 wall becomes the narrowest and gases, such as a steam, are circulated from the coil 306 lower part. Since the distance of a pipe inner wall and dispersing pipe 402 outer wall is gradually expanded as it becomes the throat part 403 and goes to the upper part from here, it becomes the diffuser part 404. Therefore, as for said two or more rocket engine jets 405, providing near [throat part 403] this is preferred.

[0023]

In this way, if the biomass fines 112 are fed from a fines feeding pipe of the dispersing pipe 402, High temperature steam generated by evaporation of the reaction water 115 flows in from the lower part, it becomes high-speed at the throat part 403, the fines 112 of dispersing pipe 402 inside are sucked out according to a Venturi effect, and the diffuser part 404 is distributed. These fines 112 that carried out distributed floating are almost gasified in an instant.

[0024]

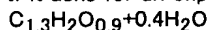
(Embodiment 4) Drawing 4 is a schematic diagram of the gasification reaction equipment 101 which has a multipipe gasification part of this invention. In a figure, as Embodiment 2 or a bend of 3 is shown in an A-A' view figure on the right-hand side of a figure, perpendicularly the multipipe coil 501 to five-row parallel. It is arranged in the heating chamber 307 and, as for a biomass fines entrance slot, ashes output port, a reaction water scraper launcher, and production gas (undried) output port, five rows are connected by the headers 502, 503, 504, and 505, respectively. Treatment space capacity increases by this and enhancement of capability is compactly possible.

[0025]

(Embodiment 5) Drawing 5 is a graph which shows a relation with temperature conditions of a gasification reaction, gas composition, and calorific value which generate floating and outside heat type quantity calorie gas of this invention. Using equipment shown in drawing 2, the steam / biomass weight ratio was fixed to 2, an examination of floating and outside heat type quantity calorie gasification of this invention was done at various temperature, a presentation of production gas was analyzed, calorific value of production gas was measured, and it asked for material balance of a reaction. As a result, when production gas gave gas composition shown in a bar graph and the calorific value was measured, it was the quantity of heat of a line graph.

[0026]

If it asks for an experimental formula of a gasification reaction from material balance of a reaction obtained above,



It came out and a certain thing was understood.

[0027]

[Effect of the Invention]

As explained in detail above, are not accompanied by generating of free carbon, such as tar and soot, by this invention. Floating and outside heat type quantity calorie gas (for example, 20 MJ/NM³) by which waste uses hydrocarbon of only some ash, such as clean H₂, CO, and CH₄, as the main ingredients are obtained. By combining with gas engine driven power generation, it can be considered as a system with high total energy efficiency.

[Brief Description of the Drawings]

[Drawing 1] The flow chart of the bioenergy utilization system centering on the gasification reaction equipment which generates

floating and outside heat type quantity calorie gas of this invention

The flow chart of *****

[Drawing 2] Gasification reaction equipment of this invention, and the schematic diagram of an example of the details of a primary gasification part

[Drawing 3] Gasification reaction equipment of this invention, and the schematic diagram of other examples of the details of a primary gasification part

[Drawing 4] Gasification reaction equipment of this invention, and the schematic diagram of a multipipe gasification part

[Drawing 5] It is a graph which shows a relation with the temperature conditions of a gasification reaction, gas composition, and calorific value which generate floating and outside heat type quantity calorie gas of this invention.

[Explanations of letters or numerals]

101 -- Gasification reaction equipment
102 -- Crushing equipment
103 -- Heat gas producer
104 -- Dehydrator
105 -- Gas tank
106 -- Gas engine
111 -- Biomass raw material
112 -- Fines
113 -- Rough part
114 -- Biomass combustion high temperature gas
115 -- Reaction water
116 -- Production gas
211 -- A steam or steamy + small-quantity air
301 -- Reaction water evaporator
302 -- primary gasification part
303 -- secondary gasification part
304 -- primary gasification region
305 -- secondary gasification region
306 -- Coil
307 -- Heating chamber
401 -- primary gasification part
402 -- Dispersing pipe
403 -- Throat part
404 -- Diffuser part
501 -- Multipipe coil
502 -- Header
503 -- Header
504 -- Header
505 -- Header

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

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The flow chart of *****

[Drawing 2]Gasification reaction equipment of this invention, and the schematic diagram of an example of the details of a primary gasification part

[Drawing 3]Gasification reaction equipment of this invention, and the schematic diagram of other examples of the details of a primary gasification part

[Drawing 4]Gasification reaction equipment of this invention, and the schematic diagram of a multipipe gasification part

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[Explanations of letters or numerals]

- 101 -- Gasification reaction equipment
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- 105 -- Gas tank
- 106 -- Gas engine
- 111 -- Biomass raw material
- 112 -- Fines
- 113 -- Rough part
- 114 -- Biomass combustion high temperature gas
- 115 -- Reaction water
- 116 -- Production gas
- 211 -- A steam or steamy + small-quantity air
- 301 -- Reaction water evaporator
- 302--primary gasification part
- 303--secondary gasification part
- 304--primary gasification region
- 305--secondary gasification region
- 306 -- Coil
- 307 -- Heating chamber
- 401--primary gasification part
- 402 -- Dispersing pipe
- 403 -- Throat part
- 404 -- Diffuser part
- 501 -- Multipipe coil
- 502 -- Header
- 503 -- Header
- 504 -- Header
- 505 -- Header

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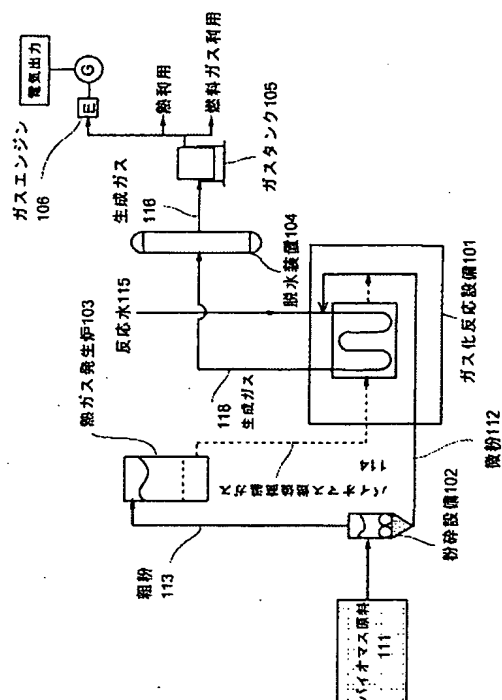
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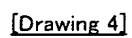
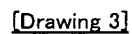
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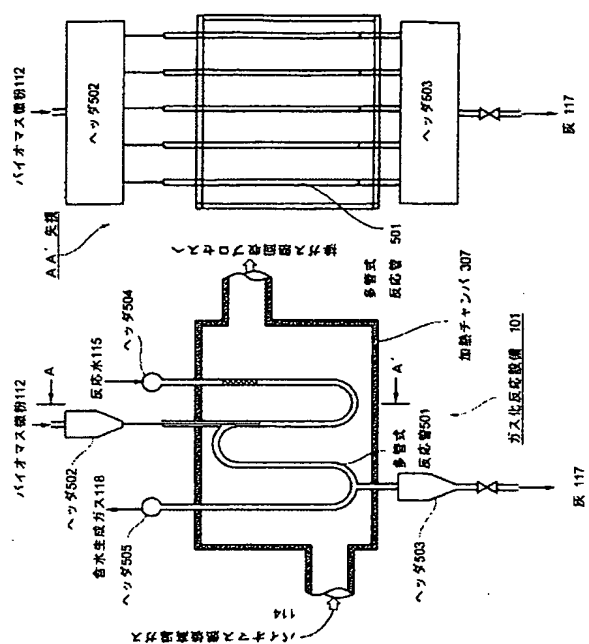
DRAWINGS

[Drawing 1]

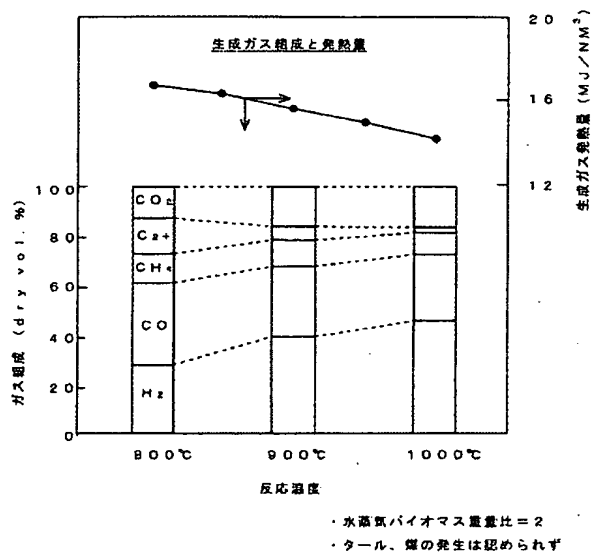


[Drawing 2]





[Drawing 5]



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【特許請求の範囲】

【請求項1】

粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、前記隔壁が内部にガス化空間を有し、外部加熱による内周側のガス化空間が管状体構造に形成され、前記ガス化空間が、供給するバイオマス粉体を、供給する水蒸気で流動化させる噴流床構造である事を特徴とするバイオマスのガス化装置。

【請求項2】

粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、前記隔壁が内部にガス化空間を有し、外部加熱による内周側のガス化空間が管状体構造に形成され、前記ガス化空間内で、水蒸気とバイオマスが向流若しくは水蒸気流れ方向と交差する方向に両者の流れ方向を設定するとともに、該接触域に絞り若しくは膨脹域（ディフューザ）が存在することを特徴とするバイオマスのガス化装置。

【請求項3】

粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、高温ガスが流出入する加熱空間に、複数の自由端開口が外部に位置している曲管を挿入し、加熱空間に曝されている曲管内で反応水蒸発部と水蒸気とバイオマスのガス化反応を行うガス化部が位置していることを特徴とするバイオマスのガス化装置。

【請求項4】

前記曲管内の二次ガス化部通過直後の曲管をバイオマス供給側より分岐して、該分岐管を下向きから上向きに向けて曲管するとともに、前記上向き自由端に燃料ガス出口部、一方下向きから上向きの底部変向部に、灰ドレンを設けたことを特徴とする請求項3記載のバイオマスのガス化装置。

【請求項5】

前記曲管が多管状に加熱空間に挿入されるとともに、該多管部の反応水側の自由端に前記多管部同士を連結するヘッダを設け、該ヘッダに充てんした反応水により実質的シールを行うことを特徴とする請求項3若しくは4記載のバイオマスのガス化装置。

【請求項6】

前記曲管が多管状に加熱空間に挿入されるとともに、該多管部のバイオマス側の自由端に前記多管部同士を連結するヘッダを設け、該ヘッダに充てんしたバイオマスにより実質的シールを行うことを特徴とする請求項3若しくは4記載のバイオマスのガス化装置。

【発明の詳細な説明】

【0001】

【発明の属する技術の分野】

本発明はバイオマスの有効利用に関し、詳しくは、バイオマスからクリーンな高カロリーガスを生成させる装置に関する。更には、従来のバイオマスエネルギー利用形態では得られないシステム発電効率の高い、給電システムもしくは熱電併給システムのガスエンジンと組み合わせて用いる、バイオマスのガス化装置に関する。

【0002】

【従来の技術】

従来のバイオマスエネルギー利用装置システムのうち、電気エネルギーもしくは熱電両エネルギーに変換して行う利用システムでは、バイオマスをボイラ用燃料として直接燃焼して、高圧蒸気を生成させ、発電用タービンを回転させる方式が執られている。従って、少なくと

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も5000～10000kWと設備規模が大きくなるので、バイオマス資源の大量集約的発生もしくは大量収集が必要である。加えて、多額の投下資本を必要とする。なによりも、その発電効率が5000kW規模の場合で10%台に留まっているため、小規模で効率の高いバイオマス資源の利用装置システムが望まれている。

【0003】

一方、ガスエンジン使用の発電では小規模でも高い発電効率が得られるので、我が国のようにバイオマス資源が分散的に発生する社会および自然環境ではバイオマスのガス化装置技術の必要性が高い。

【0004】

バイオマスのガス化装置技術については、従来より固定床、流動床型のガス化炉で、酸素もしくは空気を主たるガス化剤として、吸熱反応であるガス化の空間と燃焼による発熱空間を共通の空間に設定した、いわゆる内燃式のものが研究開発されてきたが、タール、煤が副生し、ガスエンジン用として品質が適合しない。加えて、空気をを用いる場合には、生成ガス中に窒素が残留して、単位生成ガスの発熱量を低下させる。酸素を用いる場合には、空気分離工程が別に必要で、運転に要するエネルギー及び設備投資がエネルギー効率低下要因及びコストアップ要因となる。

【0005】

他に、臨界圧熱水によるガス化装置の研究が行われているが、超高温高压装置上の問題を含み、実用化の域に達していない。

【0006】

【発明が解決しようとする課題】

本発明はかかる従来の問題点に鑑みてなされたもので、バイオマス資源から発電用ガスエンジンに適合する、高カロリーで、クリーンな燃料ガスを、高収率で取得する、小規模でも可能なバイオマスのガス化装置を提供することを目的とする。加えて、バイオマス資源の総合的エネルギー転換効率を高め、第三の新エネルギーとしての利用普及に寄与せんとするのである。

【0007】

【課題を解決するための手段】

本発明のバイオマスのガス化装置は、粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、前記隔壁が内部にガス化空間を有し、外部加熱による内周側のガス化空間が管状体構造に形成され、前記ガス化空間が、供給するバイオマス粉体を、供給する水蒸気で流動化させる噴流床構造である事を特徴とする。

【0008】

バイオマスの分解に必要な熱を、ガス化空間には化学的に影響を及ぼさない反応管壁からの射により、別途用意した熱源で供給することに加えて、ガス化剤自身の水蒸気を流動媒体として使用し、酸化反応などによる局部過熱を避け、均一な噴流状のガス化雰囲気を作る事により、速やかで、副反応のないガス化が可能な構造とする。別途用意する熱源は、バイオマスを燃焼して熱ガスを発生する、熱ガス発生炉を配置して供給することが好ましい。この熱源用バイオマスはガス分解用の原料より低品位のバイオマスを使用することもできる。

【0009】

更に本発明のバイオマスのガス化装置は、粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、前記隔壁が内部にガス化空間を有し、外部加熱による内周側のガス化空間が管状体構造に形成され、前記ガス化空間内で、水蒸気とバイオマスが向流若しくは水蒸気流れ方向と交差する方向に両者の流

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れ方向を設定するとともに、該接触域に絞り若しくは膨脹域（ディフューザ）が存在することを特徴とする。これにより、バイオマスが蒸気中に拡散し浮遊状態で、速やかにガス化する体制がつけられる。

【0010】

更に本発明のバイオマスのガス化装置は、粉碎したバイオマスに、水蒸気を供給してガス化反応を生じせしめるガス化空間と該ガス化空間が隔壁を介して外部加熱と分離されており、該にガス化空間に積極的に酸素を供給することなく吸熱反応により水蒸気とバイオマスのガス化反応を生じせしめるバイオマスのガス化装置において、高温ガスが流出入する加熱空間に、複数の自由端開口が外部に位置している曲管を送入し、加熱空間に曝されている曲管内で反応水蒸発部と水蒸気とバイオマスのガス化反応を行うガス化部が位置していることを特徴とする。

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【0011】

更に本発明のバイオマスのガス化装置は、前記曲管内のガス化部通過直後の曲管をバイオマス供給側より分岐して、該分岐管を下向きから上向きに向けて曲管するとともに、前記上向き自由端に燃料ガス出口部、一方下向きから上向きの底部変向部に、灰ドレンを設けたことを特徴とする。即ち本発明のガス化反応では、タール・煤のような遊離炭素は生成せず、唯一の固形不純物は無機物由来の灰である。蓄積する該不純物を集積して、除去する構造としてある。

【0012】

更に本発明のバイオマスのガス化装置は、前記曲管が多管状に加熱空間に挿入されるとともに、該多管部の反応水側の自由端に前記多管部同士を連結するヘッダを設け、該ヘッダに充てんした反応水により実質的シールを行うことを特徴とする。多管状にガス化空間を設けることにより、ガス化空間をコンパクトに増強することができる。

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【0013】

更に本発明のバイオマスのガス化装置は、前記曲管が多管状に加熱空間に挿入されるとともに、該多管部のバイオマス側の自由端に前記多管部同士を連結するヘッダを設け、該ヘッダに充てんしたバイオマスにより実質的シールを行うことを特徴とする。

【0014】

更に本発明のバイオマスのガス化装置は、前記バイオマスを3mm以下、好ましくは1mm以下の微粒状にする粉碎手段を備え、微粒状にする粉碎手段は例えば、破砕機とインパクトミルを組み合わせた手段でよく、微粉碎困難なバイオマスは、適時に別して、ガス化空間加熱用の熱ガスを発生させる燃料として利用すればよい。

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【0015】

【発明の実施の形態】

以下に本発明の実施の形態について図面を参照して詳しく説明する。但し本実施の形態に記載される製品の寸法、形状、材質、その相対配置等は特に特定の記載がない限りは本発明の範囲をそれのみに限定する主旨ではなく、単なる説明例に過ぎない。

【0016】

（実施例1） 図1は本発明の浮遊・外熱式高カロリーガスを生成するガス化反応設備を中心とするバイオエネルギー利用システムのフロー図である。ガス化反応設備101は後述する反応管306（図2、3参照）を備え、該反応管306は反応水115及びバイオマス微粉112を受け入れ、外部からバイオマス燃焼高温ガス114により加熱できるように構成されている。粉碎設備102はバイオマス原料111を受け入れて平均粒径3mm以下、好ましくは1mm以下の微粉を生成可能な性能を有し、平均粒径3mm以下の微粉112と平均粒径3mmを超える粗粉113とを分別して、排出可能な構造を有している。本実施例では破砕機とインパクトミルを組み合わせて用いた。熱ガス発生炉103はバイオマス粗粉113を受け入れて空気などの支燃剤によりバイオマス粗粉113を燃焼して高温のバイオマス燃焼高温ガス114を生成する。脱水装置104は内部に冷却伝熱面を持ち、塔内に導入されたガス中の水分及び硫黄化合物など高沸点物を凝縮して除去可能な構造を有す。ガスタンク105は水封式のタンクで、生成ガス116を貯留可能な構造にな

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っている。ガスエンジン106は本例における生成ガス116を燃焼して、発電機を運転可能な能力を有している。

【0017】

図1において、バイオマス原料111は粉碎設備102に供給され平均粒径3mm以下の微粉112と平均粒径3mmを超える粗粉113に分けられ、粗粉113は熱ガス発生炉103に送られ、微粉112はガス化反応設備101中の反応管306中に反応水115とともに導入される。熱ガス発生炉103ではバイオマス粗粉113を燃焼温度900～1200℃で燃焼させ、発生するバイオマス燃焼高温ガス114をガス化反応設備101中の反応管306を外部から加熱し、管内の温度を800℃以上に保つ。反応管306内に導入された微粉112は導入反応水115によって発生した水蒸気気流中に浮遊し、ほぼ瞬時(0.2秒以下)にガス化する。含水生成ガス108を脱水装置104に導入し、水分と硫黄分(H_2S)、塩素分(HCl)を除去した後、生成ガス116とし、ガスタンク105に貯留する。生成ガス116は約20MJ/m³のカロリーを有し、ガスエンジン用燃料として適合する。本システムでバイオマス処理量1トン/日(50～100kg/h)を処理して、30kWの発電機により電気エネルギーに変換したときの、総合エネルギー効率は20%以上とすることができた。

【0018】

(実施例2) 図2は本発明のガス化反応設備101と1次ガス化部302詳細の一例の概要図である。図2において、ガス化反応設備101は、加熱チャンバ307内部に反応管306を有し、加熱チャンバ307はバイオマス燃焼高温ガス114の導入口と、排出口を備えている。反応管はU字、逆U字、U字の管を連結した曲管であり、右側より第一垂直部、第二垂直部、第三垂直部、第四垂直部がある。その右端の第一垂直部上部より反応水115を導入出来る開口端が、中途第二垂直部上部よりバイオマス微粉112が導入出来る開口端が、中途第二垂直部、第三垂直部とを連結するU字管底部よりガス化によって発生する灰117を取り出す開口端が、左端第四垂直部よりガス化反応で生成した含水生成ガス118を取り出す開口端が、夫々設けてある。

【0019】

ガス化反応設備101は不図示の熱ガス発生炉で生成した、バイオマス燃焼高温ガス114を前記加熱チャンバ307の導入口より導入して、反応管306を外部より加熱し、その内温を800℃以上の適切な温度に維持するよう、バイオマス燃焼高温ガス114(外部加熱ガス)の温度及び流量を調節する。反応水115は第一垂直部の反応水蒸発部301において外部加熱ガスで加熱され水蒸気となり、第二垂直部の1次ガス化部302で上部より導入された、バイオマス微粉112を浮遊させながらガス化させる。この時、水蒸気/バイオマスのモル比が0.4以上となるように反応水115、微粉112の投入量を加減する。ガス化した生成ガスはついで、第三垂直部及び第四垂直部で構成される2次ガス化部303に流れて、少量の副生したタール・煤を分解する。この部分で固形有機物及び炭素は全て分解して、ガス体となり、固体は無機物からなる灰分のみとなり、前記灰取り出し開口端より、灰117を取り出す。生成ガス118は未だ水分と少量の H_2S と HCl を含んだ状態で前記左端第四垂直部開口端より取り出す。

【0020】

1次ガス化部302の詳細は図示の如く、反応管306の下部付近が、中央に開口部308を持つコニカル(逆円錐台)型整流板307が設けられ、該開口部308から高温蒸気が吹き込まれ、反応管306上部から投入されたバイオマス微粉112を浮遊させた状態でガス化する。1次ガス化即ち本発明の目的とするガス化は1次ガス化領域304で行われ、この領域を過ぎた第三垂直部の上部は2次ガス化領域305として機能し、前記で説明した2次ガス化部303と同様な役割を果たす。

【0021】

(実施例3) 図3は本発明のガス化反応設備と1次ガス化部詳細の他の例の概要図である。ガス化反応設備の全体構成は実施例2と同様である。1次ガス化部401詳細の構成が図示のようになっている。即ち、図3右側の1次ガス化部401詳細において、反応管

306中には分散管402が挿入されている。分散管402は微粉送入管より、底部逆コニカルの底面円周に向けて延在する曲面で構成される、内部中空の一端が逆コニカルで閉鎖された、筒体であり、該底部逆コニカルの底面円周に向けて延在する曲面上に複数の噴出口405を有している。

【0022】

前記反応管306に、該分散管402を挿入すると、分散管402の逆コニカル底面円周部付近と、反応管306内壁との間の距離が最も狭小となり、反応管306下部より蒸気など気体を流通させたとき、スロート部403となり、ここから上部に行くに従い、漸次管内壁と分散管402外壁との距離は拡大していくので、ディフューザ部404となる。従って、前記複数の噴出口405はこのスロート部403付近に設けることが好ましい。

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【0023】

かくして、分散管402の微粉送入管よりバイオマス微粉112を送入すると、反応水115の蒸発によって生成した高温蒸気が下部より流れ込み、スロート部403で高速となって、ベンチュリー効果により分散管402内部の微粉112を吸い出してディフューザ部404に分散させる。該分散浮遊した微粉112はほとんど瞬時にガス化する。

【0024】

(実施例4) 図4は本発明の多管式ガス化部を有するガス化反応設備101の概要図である。図において、多管式反応管501は実施例2もしくは3の曲管が図右側のA-A'矢視図に示されるように垂直方向に5列並列に、加熱チャンバ307内に配置されており、バイオマス微粉投入口、灰取り出し口、反応水送入口、生成ガス(未脱水)取り出し口はそれぞれヘッダ502、503、504、505で5列が連結されている。これにより、処理空間容量が増加し、コンパクトに能力の増強が可能である。

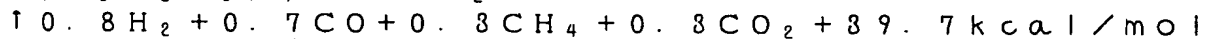
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【0025】

(実施例5) 図5は本発明の浮遊・外熱式高カロリーガスを生成するガス化反応の温度条件とガス組成及び発熱量との関係を示すグラフである。図2に示す装置を用い本発明の浮遊・外熱式高カロリーガス化の試験を、水蒸気/バイオマス重量比を2に固定して、各種温度で行い、生成ガスの組成を分析し、生成ガスの発熱量を測定して、反応のマテリアルバランスを求めた。その結果生成ガスは棒グラフに示すガス組成を与え、その発熱量を測定すると、折れ線グラフの熱量であった。

【0026】

上記で得られた反応のマテリアルバランスよりガス化反応の経験式を求めると、



であることがわかった。

【0027】

【発明の効果】

以上詳しく説明したように、本発明によりタール、煤など遊離炭素の発生を伴わない、廃棄物は若干の灰分のみ、クリーンな H_2 、 CO 、及び CH_4 などの炭化水素を主成分とする浮遊・外熱式高カロリーガス(例えば $20MJ/NM^3$)が得られ、ガスエンジン発電と組合すことにより、総合エネルギー効率の高いシステムとすることができる。

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【図面の簡単な説明】

【図1】本発明の浮遊・外熱式高カロリーガスを生成するガス化反応設備を中心とする、バイオエネルギー利用システムのフロー図

送手段のフロー図

【図2】本発明のガス化反応設備と1次ガス化部詳細の一例の概要図

【図3】本発明のガス化反応設備と1次ガス化部詳細の他の例の概要図

【図4】本発明のガス化反応設備と多管式ガス化部の概要図

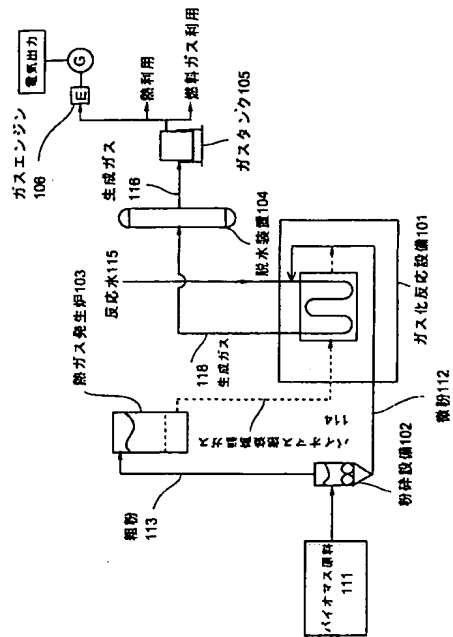
【図5】本発明の浮遊・外熱式高カロリーガスを生成するガス化反応の温度条件とガス組成及び発熱量との関係を示すグラフである。

【符号の説明】

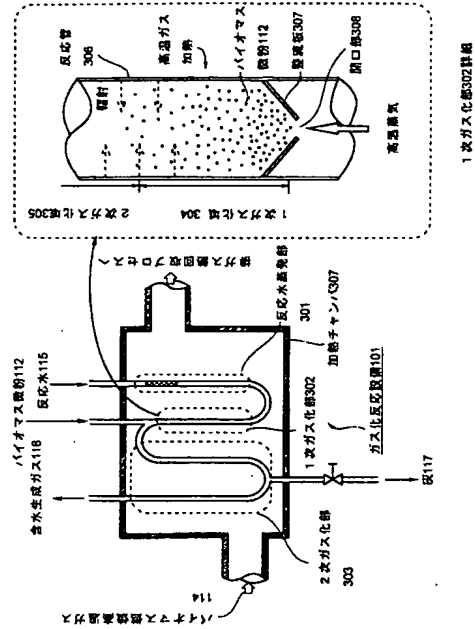
50

1 0 1	ガス化反応設備	
1 0 2	粉碎設備	
1 0 3	熱ガス発生炉	
1 0 4	脱水装置	
1 0 5	ガスタンク	
1 0 6	ガスエンジン	
1 1 1	バイオマス原料	
1 1 2	微粉	
1 1 3	粗分	
1 1 4	バイオマス燃焼高温ガス	10
1 1 5	反応水	
1 1 6	生成ガス	
2 1 1	蒸気又は蒸気＋少量空気	
3 0 1	反応水蒸発部	
3 0 2	1次ガス化部	
3 0 3	2次ガス化部	
3 0 4	1次ガス化域	
3 0 5	2次ガス化域	
3 0 6	反応管	
3 0 7	加熱チャンバ	20
4 0 1	1次ガス化部	
4 0 2	分散管	
4 0 3	スロート部	
4 0 4	ディフューザ部	
5 0 1	多管式反応管	
5 0 2	ヘッダ	
5 0 3	ヘッダ	
5 0 4	ヘッダ	
5 0 5	ヘッダ	

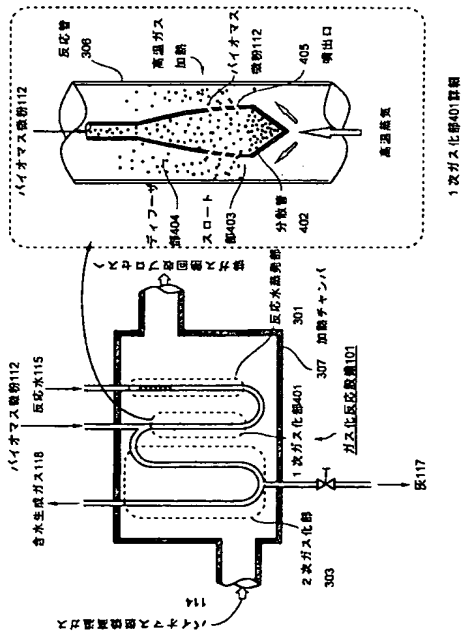
【図 1】



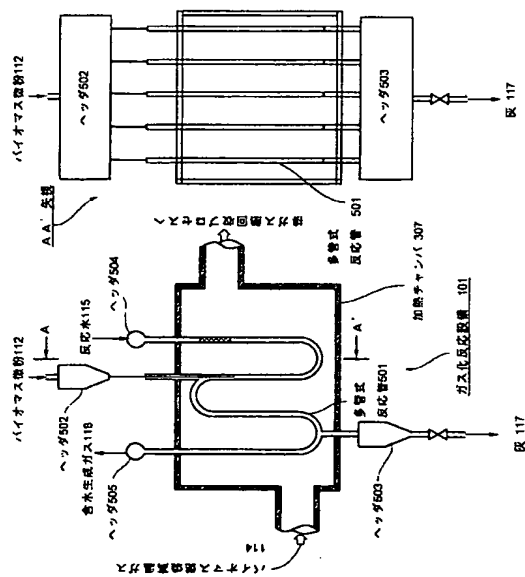
【図 2】



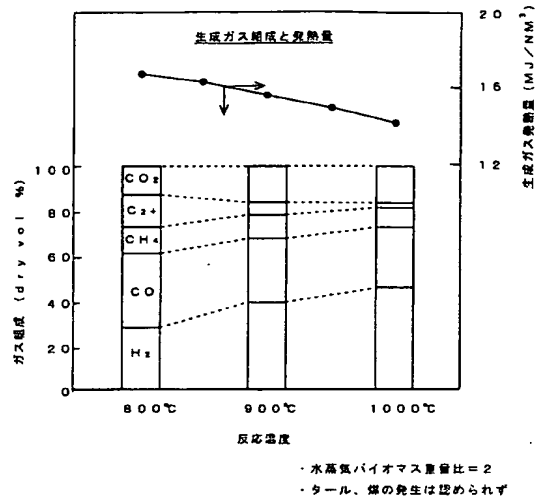
【図 3】



【図 4】



【図 5】



フロントページの続き

(51)Int. Cl.⁷

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